

191S143 GB
SEQUENCE LISTING

<110> COMPAGNIE GERVAIS DANONE
GENDRE, François
BENBADIS, Laurent
BRIGNON, Pierre

<120> MUTANT LACTOBACILLUS BULGARICUS STRAINS FREE
FROM BETA-GALACTOSIDASE ACTIVITY

<130> MJPcb191/143

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<150> FR9806456

<151> 1998-05-22

<160> 3

<170> PatentIn Ver. 2.1

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<211> 5059

<212> DNA

<213> Lactobacillus bulgaricus

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<221> CDS

<222> (122)..(1873)

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<222> (1877)..(4519)

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g atg atc ttt atc atc acc aac ttg atc acc gcc atc cgg atc ggg gaa 169

Met	Ile	Phe	Ile	Ile	Thr	Asn	Leu	Ile	Thr	Ala	Ile	Arg	Ile	Gly	Glu
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gtc ctg ctc gac ccc ttg atc ggt aac gcc atc gac cgg acc gaa agc 217
 Val Leu Leu Asp₂₀ Pro Leu Ile Gly Asn₂₅ Ala Ile Asp Arg Thr₃₀ Glu Ser
 cgg tgg ggg aag ttc aag ccc tgg gtt gtg ggc ggg ggg atc atc agc 265
 Arg Trp Gly₃₅ Lys Phe Lys Pro Trp₄₀ Val Val Gly Gly Gly₄₅ Ile Ile Ser
 tca tta gcc ctc tta gcc ctc ttt acc gac ttt ggc ggc att aac caa 313
 Ser Leu₅₀ Ala Leu Leu Ala Leu₅₅ Phe Thr Asp Phe Gly₆₀ Gly Ile Asn Gln
 agc aac ccc gtt gtt tac tta gta atc ttc ggt att gtt tac ttg att 361
 Ser₆₅ Asn Pro Val Val Tyr₇₀ Leu Val Ile Phe Gly₇₅ Ile Val Tyr Leu₈₀ Ile
 atg gat atc ttc tac tca ttt aaa gac act ggc ttc tgg gcc atg atc 409
 Met Asp Ile Phe Tyr₈₅ Ser Phe Lys Asp Thr₉₀ Gly Phe Trp Ala Met₉₅ Ile
 ccg gcc ttg tcc ctg gat tcc cgg gaa aga gag aag acc tcc acc ttc 457
 Pro Ala Leu Ser₁₀₀ Leu Asp Ser Arg Glu₁₀₅ Arg Glu Lys Thr Ser Thr Phe
 gcc aga gtc ggc tcc acc atc ggg gcc aac ctg gtc ggg gta gtc atc 505
 Ala Arg Val₁₁₅ Gly Ser Thr Ile Gly₁₂₀ Ala Asn Leu Val Gly₁₂₅ Val Val Ile
 acc cca atc atc ctc ttc ttc tcg gcc agc aag gcc aac ccc aac ggg 553
 Thr Pro₁₃₀ Ile Ile Leu Phe Phe₁₃₅ Ser Ala Ser Lys Ala₁₄₀ Asn Pro Asn Gly
 gat aag cag ggc tgg ttc ttc ttt gcc ttg atc gtg gcc att gtc ggc 601
 Asp₁₄₅ Lys Gln Gly Trp Phe₁₅₀ Phe Phe Ala Leu Ile₁₅₅ Val Ala Ile Val Gly₁₆₀
 atc ttg acc tca att acc gtt ggt ctt ggt act cac gaa gta aaa tcc 649
 Ile Leu Thr Ser Ile Thr Val Gly Leu Gly Thr His Glu Val Lys Ser

175

gcc	ctg	cgg	gaa	agc	aat	gaa	aag	acc	act	ttg	aag	cag	gtc	ttt	aag	697
Ala	Leu	Arg	Glu 180	Ser	Asn	Glu	Lys	Thr 185	Thr	Leu	Lys	Gln	Val 190	Phe	Lys	
gtc	ctg	ggg	caa	aac	gac	cag	ctc	ctc	tgg	ctg	gcc	ttt	gcc	tac	tgg	745
Val	Leu	Gly 195	Gln	Asn	Asp	Gln	Leu 200	Leu	Trp	Leu	Ala	Phe 205	Ala	Tyr	Trp	
ttt	tac	ggc	ctg	ggt	atc	aac	acc	ctg	aac	gct	ctg	caa	ctt	tac	tac	793
Phe	Tyr 210	Gly	Leu	Gly	Ile	Asn 215	Thr	Leu	Asn	Ala	Leu 220	Gln	Leu	Tyr	Tyr	
ttc	tca	tac	atc	tta	ggc	gat	gcc	cgc	ggc	tac	agc	ctg	ctt	tac	acc	841
Phe 225	Ser	Tyr	Ile	Leu	Gly 230	Asp	Ala	Arg	Gly	Tyr 235	Ser	Leu	Leu	Tyr	Thr 240	
atc	aac	acc	ttt	gtc	ggt	tta	atc	tct	gca	tcc	ttc	ttc	cca	tca	ctg	889
Ile	Asn	Thr	Phe	Val 245	Gly	Leu	Ile	Ser	Ala 250	Ser	Phe	Phe	Pro	Ser 255	Leu	
gcc	aag	aag	ttc	aac	aga	aat	cgc	ctc	ttc	tac	gcc	tgc	atc	gcg	gtg	937
Ala	Lys	Lys	Phe 260	Asn	Arg	Asn	Arg	Leu 265	Phe	Tyr	Ala	Cys	Ile 270	Ala	Val	
atg	ctg	tta	ggg	atc	ggg	gtc	ttc	tcc	gtg	gcc	agc	ggt	tct	ctg	gcc	985
Met	Leu 275	Leu	Gly	Ile	Gly	Val	Phe 280	Ser	Val	Ala	Ser	Gly 285	Ser	Leu	Ala	
ctg	tcc	ctt	gtt	ggg	gca	gaa	ttc	ttc	ttt	att	ccg	cag	cct	ctg	gcc	1033
Leu	Ser 290	Leu	Val	Gly	Ala	Glu 295	Phe	Phe	Phe	Ile	Pro 300	Gln	Pro	Leu	Ala	
ttc	ctg	gtc	gtt	ttg	atg	atc	atc	tct	gac	gct	gtt	gaa	tac	ggc	cag	1081
Phe 305	Leu	Val	Val	Leu	Met 310	Ile	Ile	Ser	Asp	Ala 315	Val	Glu	Tyr	Gly	Gln 320	
ctg	aaa	act	ggc	cac	aga	gac	gaa	gct	ttg	acc	ctg	tct	gtc	cgg	cca	1129

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Leu	Lys	Thr	Gly	His	Arg	Asp	Glu	Ala	Leu	Thr	Leu	Ser	Val	Arg	Pro	
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ttg	gtc	gat	aag	ctg	ggc	ggg	gcc	ttg	tcc	aac	tgg	ttt	gtt	tcc	ttg	1177
Leu	Val	Asp	Lys	Leu	Gly	Gly	Ala	Leu	Ser	Asn	Trp	Phe	Val	Ser	Leu	
			340					345					350			
att	gcc	tta	act	gcc	ggc	atg	acc	act	ggg	gcg	act	gcc	tca	aca	att	1225
Ile	Ala	Leu	Thr	Ala	Gly	Met	Thr	Thr	Gly	Ala	Thr	Ala	Ser	Thr	Ile	
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aca	gct	cat	ggc	cag	atg	gtc	ttc	aag	tta	gct	atg	ttt	gcc	tta	ccg	1273
Thr	Ala	His	Gly	Gln	Met	Val	Phe	Lys	Leu	Ala	Met	Phe	Ala	Leu	Pro	
	370					375					380					
gca	gtc	atg	ctc	ttg	atc	gct	gtt	tct	att	ttc	gcc	aaa	aag	gtc	ttc	1321
Ala	Val	Met	Leu	Leu	Ile	Ala	Val	Ser	Ile	Phe	Ala	Lys	Lys	Val	Phe	
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Leu	Thr	Glu	Glu	Lys	His	Ala	Glu	Ile	Val	Asp	Gln	Leu	Glu	Thr	Gln	
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ttc	agc	caa	agc	cat	gcc	caa	aag	ccg	gcg	caa	gct	gaa	agc	ttc	act	1417
Phe	Ser	Gln	Ser	His	Ala	Gln	Lys	Pro	Ala	Gln	Ala	Glu	Ser	Phe	Thr	
			420					425					430			
ttg	gcc	agc	cca	gtc	tcc	gga	caa	tta	atg	aac	ctg	gac	atg	gtt	gac	1465
Leu	Ala	Ser	Pro	Val	Ser	Gly	Gln	Leu	Met	Asn	Leu	Asp	Met	Val	Asp	
		435					440					445				
gac	ccg	gtc	ttt	gcc	gac	aaa	aag	tta	ggc	gac	ggc	ttt	gcc	ctg	gtg	1513
Asp	Pro	Val	Phe	Ala	Asp	Lys	Lys	Leu	Gly	Asp	Gly	Phe	Ala	Leu	Val	
	450					455					460					
cca	gca	gac	ggt	aag	gtc	tac	gcg	cca	ttt	gcc	ggt	act	gtc	cgc	cag	1561
Pro	Ala	Asp	Gly	Lys	Val	Tyr	Ala	Pro	Phe	Ala	Gly	Thr	Val	Arg	Gln	
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 Leu Ala Lys Thr Arg His Ser Ile Val Leu Glu Asn Glu His Gly Val
 485 490 495
 ttg gtc ttg att cac ctt ggc ctg ggc acg gtc aaa tta aac ggg act 1657
 Leu Val Leu Ile His Leu Gly Leu Gly Thr Val Lys Leu Asn Gly Thr
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 ggc ttt gtc agc tat gtt gaa gag ggc agc cag gta gaa gcc ggc cag 1705
 Gly Phe Val Ser Tyr Val Glu Glu Gly Ser Gln Val Glu Ala Gly Gln
 515 520 525
 cag atc ctg gaa ttc tgg gac ccg gcg atc aag cag gcc aag ctg gac 1753
 Gln Ile Leu Glu Phe Trp Asp Pro Ala Ile Lys Gln Ala Lys Leu Asp
 530 535 540
 gac acg gta atc gtg acc gtc atc aac agc gaa act ttc gca aat agc 1801
 Asp Thr Val Ile Val Thr Val Ile Asn Ser Glu Thr Phe Ala Asn Ser
 545 550 555 560
 cag atg ctc ttg ccg atc ggc cac agc gtc caa gcc ctg gat gat gta 1849
 Gln Met Leu Leu Pro Ile Gly His Ser Val Gln Ala Leu Asp Asp Val
 565 570 575
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 Phe Lys Leu Glu Gly Lys Asn Met Ser Asn Lys Leu Val Lys
 580 585 590
 gaa aaa aga gtt gac cag gca gac ttg gcc tgg ctg act gac ccg gaa 1945
 Glu Lys Arg Val Asp Gln Ala Asp Leu Ala Trp Leu Thr Asp Pro Glu
 595 600 605
 gtt tac gaa gtc aat aca att ccc ccg cac tcc gac cat gag tcc ttc 1993
 Val Tyr Glu Val Asn Thr Ile Pro Pro His Ser Asp His Glu Ser Phe
 610 615 620
 caa agc cag gaa gaa ctg gag gag ggc aag tcc agt tta gtg cag tcc 2041

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Gln Ser Gln Glu Glu Leu Glu Glu Gly Lys Ser Ser Leu Val Gln Ser
 625 630 635
 ctg gac ggg gac tgg ctg att gac tac gct gaa aac ggc cag gga cca 2089
 Leu Asp Gly Asp Trp Leu Ile Asp Tyr Ala Glu Asn Gly Gln Gly Pro
 640 645 650 655
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 Val Asn Phe Tyr Ala Glu Asp Phe Asp Asp Ser Asn Phe Lys Ser Val
 660 665 670
 aaa gta ccc ggc aac ctg gaa ctg caa ggc ttt ggc cag ccc cag tat 2185
 Lys Val Pro Gly Asn Leu Glu Leu Gln Gly Phe Gly Gln Pro Gln Tyr
 675 680 685
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 Val Asn Val Gln Tyr Pro Trp Asp Gly Ser Glu Glu Ile Phe Pro Pro
 690 695 700
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 Gln Ile Pro Ser Lys Asn Pro Leu Ala Ser Tyr Val Arg Tyr Phe Asp
 705 710 715
 ctg gat gaa gct ttc tgg gac aag gaa gtc agc ttg aag ttt gac ggg 2329
 Leu Asp Glu Ala Phe Trp Asp Lys Glu Val Ser Leu Lys Phe Asp Gly
 720 725 730 735
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 Ala Ala Thr Ala Ile Tyr Val Trp Leu Asn Gly His Phe Val Gly Tyr
 740 745 750
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 Gly Glu Asp Ser Phe Thr Pro Ser Glu Phe Met Val Thr Lys Phe Leu
 755 760 765
 aag aaa gaa aat aac cgc ctg gca gtg gct ctc tac aag tat tct tcc 2473
 Lys Lys Glu Asn Asn Arg Leu Ala Val Ala Leu Tyr Lys Tyr Ser Ser
 770 775 780

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Ala Ser Trp Leu Glu Asp Gln Asp Phe Trp Arg Met Ser Gly Leu Phe
785 790 795

aga tca gtg act ctt cag gcc aag ccg cgt ctg cac ttg gag gac ctt 2569
Arg Ser Val Thr Leu Gln Ala Lys Pro Arg Leu His Leu Glu Asp Leu
800 805 810 815

aag ctt acg gcc agc ttg acc gat aac tac caa aaa gga aag ctg gaa 2617
Lys Leu Thr Ala Ser Leu Thr Asp Asn Tyr Gln Lys Gly Lys Leu Glu
820 825 830

gtc gaa gcc aat att gcc tac cgc ttg cca aat gcc agc ttt aag ctg 2665
Val Glu Ala Asn Ile Ala Tyr Arg Leu Pro Asn Ala Ser Phe Lys Leu
835 840 845

gaa gtg cgg gat agt gaa ggt gac ttg gtt gct gaa aag ctg ggc cca 2713
Glu Val Arg Asp Ser Glu Gly Asp Leu Val Ala Glu Lys Leu Gly Pro
850 855 860

atc aga agc gag cag ctg gaa ttc act ctg gct gat ttg cca gta gct 2761
Ile Arg Ser Glu Gln Leu Glu Phe Thr Leu Ala Asp Leu Pro Val Ala
865 870 875

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Ala Trp Ser Ala Glu Lys Pro Asn Leu Tyr Gln Val Arg Leu Tyr Leu
880 885 890 895

tac cag gca ggc agc ctc tta gag gtt agc cgg cag gaa gtg ggt ttc 2857
Tyr Gln Ala Gly Ser Leu Leu Glu Val Ser Arg Gln Glu Val Gly Phe
900 905 910

cgc aac ttt gaa cta aaa gac ggg att atg tac ctt aac ggc cag cgg 2905
Arg Asn Phe Glu Leu Lys Asp Gly Ile Met Tyr Leu Asn Gly Gln Arg
915 920 925

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cgg gct atc aca gaa gag gat atg atc tgg gat atc aag acc atg aag			3001
Arg Ala Ile Thr Glu Glu Asp Met Ile Trp Asp Ile Lys Thr Met Lys	945	950 955	
cga agc aac atc aat gct gtc cgc tgc tct cac tac ccg aac cag tcc			3049
Arg Ser Asn Ile Asn Ala Val Arg Cys Ser His Tyr Pro Asn Gln Ser	960	965 970 975	
ctc ttt tac cgg ctc tgt gac aag tac ggc ctt tac gtc att gat gaa			3097
Leu Phe Tyr Arg Leu Cys Asp Lys Tyr Gly Leu Tyr Val Ile Asp Glu	980	985 990	
gct aac ctg gaa agc cac ggc acc tgg gaa aaa gtg ggg ggg cac gaa			3145
Ala Asn Leu Glu Ser His Gly Thr Trp Glu Lys Val Gly Gly His Glu	995	1000 1005	
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Asp Pro Ser Phe Asn Val Pro Gly Asp Asp Gln His Trp Leu Gly Ala	1010	1015 1020	
agc tta tcc cgg gtg aag aac atg atg gct cgg gac aag aac cat gct			3241
Ser Leu Ser Arg Val Lys Asn Met Met Ala Arg Asp Lys Asn His Ala	1025	1030 1035	
tca atc ctg atc tgg tct tta ggc aat gag tct tac gcc ggc act gtc			3289
Ser Ile Leu Ile Trp Ser Leu Gly Asn Glu Ser Tyr Ala Gly Thr Val	1040	1045 1050 1055	
ttt gcc caa atg gct gat tac gtc cgg aag gct gat ccg acc cgg gtt			3337
Phe Ala Gln Met Ala Asp Tyr Val Arg Lys Ala Asp Pro Thr Arg Val	1060	1065 1070	
cag cac tat gaa ggg gtg acc cac aac cgg aag ttt gac gac gcc acc			3385
Gln His Tyr Glu Gly Val Thr His Asn Arg Lys Phe Asp Asp Ala Thr	1075	1080 1085	
cag att gaa agc cgg atg tat gct ccg gcc aag gta att gaa gaa tac			3433

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 Leu Thr Asn Lys Pro Ala Lys Pro Phe Ile Ser Val Glu Tyr Ala His
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 gcc atg ggc aac tcc gtc ggt gac ctg gcc gcc tac acg gcc ctg gaa 3529
 Ala Met Gly Asn Ser Val Gly Asp Leu Ala Ala Tyr Thr Ala Leu Glu
 1120 1125 1130 1135
 aaa tac ccc cac tac cag ggc ggc ttc atc tgg gac tgg att gac caa 3577
 Lys Tyr Pro His Tyr Gln Gly Gly Phe Ile Trp Asp Trp Ile Asp Gln
 1140 1145 1150
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 Gly Leu Glu Lys Asp Gly His Leu Leu Tyr Gly Gly Asp Phe Asp Asp
 1155 1160 1165
 cgg cca acc gac tat gaa ttc tgc ggg aac ggc ctg gtc ttt gct gac 3673
 Arg Pro Thr Asp Tyr Glu Phe Cys Gly Asn Gly Leu Val Phe Ala Asp
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 Arg Thr Glu Ser Pro Lys Leu Ala Asn Val Lys Ala Leu Tyr Ala Asn
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 Leu Lys Leu Glu Val Lys Asp Gly Gln Leu Phe Leu Lys Asn Asp Asn
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 tta ttt acc aac agc tca tct tac tac ttc ttg act agt ctt ttg gtc 3817
 Leu Phe Thr Asn Ser Ser Ser Tyr Tyr Phe Leu Thr Ser Leu Leu Val
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 gat ggc aag ttg acc tac cag agc cgg cct ctg acc ttt ggc ctg gag 3865
 Asp Gly Lys Leu Thr Tyr Gln Ser Arg Pro Leu Thr Phe Gly Leu Glu
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 Pro Gly Glu Ser Gly Thr Phe Ala Leu Pro Trp Pro Glu Val Ala Asp
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 Leu Pro Trp Ala Asp Glu Gly Phe Thr Val Ala Glu Ala Glu Glu Val
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 Ala Gln Lys Leu Pro Glu Phe Lys Pro Glu Gly Arg Pro Asp Leu Val
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 Asp Ser Asp Tyr Asn Leu Gly Leu Lys Gly Asn Asn Phe Gln Ile Leu
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 Asn Ala Gly Lys Tyr Ala Arg Leu Lys Asp Ile Ser Cys Glu Val Lys
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 90. *Chlorophyll cl* (Chl *cl*)
 91. *Chlorophyll cm* (Chl *cm*)
 92. *Chlorophyll cn* (Chl *cn*)
 93. *Chlorophyll co* (Chl *co*)
 94. *Chlorophyll cp* (Chl *cp*)
 95. *Chlorophyll cq* (Chl *cq*)
 96. *Chlorophyll cr* (Chl *cr*)
 97. *Chlorophyll cs* (Chl *cs*)
 98. *Chlorophyll ct* (Chl *ct*)
 99. *Chlorophyll cu* (Chl *cu*)
 100. *Chlorophyll cv* (Chl *cv*)
 101. *Chlorophyll cw* (Chl *cw*)
 102. *Chlorophyll cx* (Chl *cx*)
 103. *Chlorophyll cy* (Chl *cy*)
 104. *Chlorophyll cz* (Chl *cz*)
 105. *Chlorophyll da* (Chl *da*)
 106. *Chlorophyll db* (Chl *db*)
 107. *Chlorophyll dc* (Chl *dc*)
 108. *Chlorophyll dd* (Chl *dd*)
 109. *Chlorophyll de* (Chl *de*)
 110. *Chlorophyll df* (Chl *df*)
 111. *Chlorophyll dg* (Chl *dg*)
 112. *Chlorophyll dh* (Chl *dh*)
 113. *Chlorophyll di* (Chl *di*)
 114. *Chlorophyll dj* (Chl *dj*)
 115. *Chlorophyll dk* (Chl *dk*)
 116. *Chlorophyll dl* (Chl *dl*)
 117. *Chlorophyll dm* (Chl *dm*)
 118. *Chlorophyll dn* (Chl *dn*)
 119. *Chlorophyll do* (Chl *do*)
 120. *Chlorophyll dp* (Chl *dp*)
 121. *Chlorophyll dq* (Chl *dq*)
 122. *Chlorophyll dr* (Chl *dr*)
 123. *Chlorophyll ds* (Chl *ds*)
 124. *Chlorophyll dt* (Chl *dt*)
 125. *Chlorophyll du* (Chl *du*)
 126. *Chlorophyll dv* (Chl *dv*)
 127. *Chlorophyll dw* (Chl *dw*)
 128. *Chlorophyll dx* (Chl *dx*)
 129. *Chlorophyll dy* (Chl *dy*)
 130. *Chlorophyll dz* (Chl *dz*)
 131. *Chlorophyll ea* (Chl *ea*)
 132. *Chlorophyll eb* (Chl *eb*)
 133. *Chlorophyll ec* (Chl *ec*)
 134. *Chlorophyll ed* (Chl *ed*)
 135. *Chlorophyll ee* (Chl *ee*)
 136. *Chlorophyll ef* (Chl *ef*)
 1

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<210> 2
 <211> 583
 <212> PRT
 <213> Lactobacillus bulgaricus

<400> 2

Met	Ile	Phe	Ile	Ile	Thr	Asn	Leu	Ile	Thr	Ala	Ile	Arg	Ile	Gly	Glu
1				5					10					15	
Val	Leu	Leu	Asp	Pro	Leu	Ile	Gly	Asn	Ala	Ile	Asp	Arg	Thr	Glu	Ser
			20					25					30		
Arg	Trp	Gly	Lys	Phe	Lys	Pro	Trp	Val	Val	Gly	Gly	Gly	Ile	Ile	Ser
		35					40					45			
Ser	Leu	Ala	Leu	Leu	Ala	Leu	Phe	Thr	Asp	Phe	Gly	Gly	Ile	Asn	Gln
	50					55					60				
Ser	Asn	Pro	Val	Val	Tyr	Leu	Val	Ile	Phe	Gly	Ile	Val	Tyr	Leu	Ile
	65				70					75					80
Met	Asp	Ile	Phe	Tyr	Ser	Phe	Lys	Asp	Thr	Gly	Phe	Trp	Ala	Met	Ile
				85					90					95	
Pro	Ala	Leu	Ser	Leu	Asp	Ser	Arg	Glu	Arg	Glu	Lys	Thr	Ser	Thr	Phe
			100					105					110		
Ala	Arg	Val	Gly	Ser	Thr	Ile	Gly	Ala	Asn	Leu	Val	Gly	Val	Val	Ile
		115					120					125			
Thr	Pro	Ile	Ile	Leu	Phe	Phe	Ser	Ala	Ser	Lys	Ala	Asn	Pro	Asn	Gly
	130					135					140				
Asp	Lys	Gln	Gly	Trp	Phe	Phe	Phe	Ala	Leu	Ile	Val	Ala	Ile	Val	Gly
	145				150					155					160
Ile	Leu	Thr	Ser	Ile	Thr	Val	Gly	Leu	Gly	Thr	His	Glu	Val	Lys	Ser
				165					170					175	
Ala	Leu	Arg	Glu	Ser	Asn	Glu	Lys	Thr	Thr	Leu	Lys	Gln	Val	Phe	Lys
			180					185					190		
Val	Leu	Gly	Gln	Asn	Asp	Gln	Leu	Leu	Trp	Leu	Ala	Phe	Ala	Tyr	Trp
		195				200						205			

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Phe	Tyr	Gly	Leu	Gly	Ile	Asn	Thr	Leu	Asn	Ala	Leu	Gln	Leu	Tyr	Tyr
210						215					220				
Phe	Ser	Tyr	Ile	Leu	Gly	Asp	Ala	Arg	Gly	Tyr	Ser	Leu	Leu	Tyr	Thr
225					230					235					240
Ile	Asn	Thr	Phe	Val	Gly	Leu	Ile	Ser	Ala	Ser	Phe	Phe	Pro	Ser	Leu
				245					250					255	
Ala	Lys	Lys	Phe	Asn	Arg	Asn	Arg	Leu	Phe	Tyr	Ala	Cys	Ile	Ala	Val
			260					265					270		
Met	Leu	Leu	Gly	Ile	Gly	Val	Phe	Ser	Val	Ala	Ser	Gly	Ser	Leu	Ala
		275					280					285			
Leu	Ser	Leu	Val	Gly	Ala	Glu	Phe	Phe	Phe	Ile	Pro	Gln	Pro	Leu	Ala
		290				295					300				
Phe	Leu	Val	Val	Leu	Met	Ile	Ile	Ser	Asp	Ala	Val	Glu	Tyr	Gly	Gln
305					310					315					320
Leu	Lys	Thr	Gly	His	Arg	Asp	Glu	Ala	Leu	Thr	Leu	Ser	Val	Arg	Pro
				325					330					335	
Leu	Val	Asp	Lys	Leu	Gly	Gly	Ala	Leu	Ser	Asn	Trp	Phe	Val	Ser	Leu
			340					345					350		
Ile	Ala	Leu	Thr	Ala	Gly	Met	Thr	Thr	Gly	Ala	Thr	Ala	Ser	Thr	Ile
		355					360					365			
Thr	Ala	His	Gly	Gln	Met	Val	Phe	Lys	Leu	Ala	Met	Phe	Ala	Leu	Pro
	370					375					380				
Ala	Val	Met	Leu	Leu	Ile	Ala	Val	Ser	Ile	Phe	Ala	Lys	Lys	Val	Phe
385					390					395					400
Leu	Thr	Glu	Glu	Lys	His	Ala	Glu	Ile	Val	Asp	Gln	Leu	Glu	Thr	Gln
				405					410					415	
Phe	Ser	Gln	Ser	His	Ala	Gln	Lys	Pro	Ala	Gln	Ala	Glu	Ser	Phe	Thr
			420					425					430		
Leu	Ala	Ser	Pro	Val	Ser	Gly	Gln	Leu	Met	Asn	Leu	Asp	Met	Val	Asp
		435					440					445			
Asp	Pro	Val	Phe	Ala	Asp	Lys	Lys	Leu	Gly	Asp	Gly	Phe	Ala	Leu	Val
	450					455					460				

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Pro Ala Asp Gly Lys Val Tyr Ala Pro Phe Ala Gly Thr Val Arg Gln
465 470 475 480

Leu Ala Lys Thr Arg His Ser Ile Val Leu Glu Asn Glu His Gly Val
485 490 495

Leu Val Leu Ile His Leu Gly Leu Gly Thr Val Lys Leu Asn Gly Thr
500 505 510

Gly Phe Val Ser Tyr Val Glu Glu Gly Ser Gln Val Glu Ala Gly Gln
515 520 525

Gln Ile Leu Glu Phe Trp Asp Pro Ala Ile Lys Gln Ala Lys Leu Asp
530 535 540

Asp Thr Val Ile Val Thr Val Ile Asn Ser Glu Thr Phe Ala Asn Ser
545 550 555 560

Gln Met Leu Leu Pro Ile Gly His Ser Val Gln Ala Leu Asp Asp Val
565 570 575

Phe Lys Leu Glu Gly Lys Asn
580

<210> 3

<211> 880

<212> PRT

<213> Lactobacillus bulgaricus

<400> 3

Met Ser Asn Lys Leu Val Lys Glu Lys Arg Val Asp Gln Ala Asp Leu
1 5 10 15

Ala Trp Leu Thr Asp Pro Glu Val Tyr Glu Val Asn Thr Ile Pro Pro
20 25 30

His Ser Asp His Glu Ser Phe Gln Ser Gln Glu Glu Leu Glu Glu Gly
35 40 45

Lys Ser Ser Leu Val Gln Ser Leu Asp Gly Asp Trp Leu Ile Asp Tyr
50 55 60

Ala Glu Asn Gly Gln Gly Pro Val Asn Phe Tyr Ala Glu Asp Phe Asp
65 70 75 80

Asp Ser Asn Phe Lys Ser Val Lys Val Pro Gly Asn Leu Glu Leu Gln
85 90 95

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Gly	Phe	Gly	Gln	Pro	Gln	Tyr	Val	Asn	Val	Gln	Tyr	Pro	Trp	Asp	Gly			
			100					105					110					
Ser	Glu	Glu	Ile	Phe	Pro	Pro	Gln	Ile	Pro	Ser	Lys	Asn	Pro	Leu	Ala			
		115					120					125						
Ser	Tyr	Val	Arg	Tyr	Phe	Asp	Leu	Asp	Glu	Ala	Phe	Trp	Asp	Lys	Glu			
	130					135					140							
Val	Ser	Leu	Lys	Phe	Asp	Gly	Ala	Ala	Thr	Ala	Ile	Tyr	Val	Trp	Leu			
145					150					155					160			
Asn	Gly	His	Phe	Val	Gly	Tyr	Gly	Glu	Asp	Ser	Phe	Thr	Pro	Ser	Glu			
				165					170					175				
Phe	Met	Val	Thr	Lys	Phe	Leu	Lys	Lys	Glu	Asn	Asn	Arg	Leu	Ala	Val			
			180					185					190					
Ala	Leu	Tyr	Lys	Tyr	Ser	Ser	Ala	Ser	Trp	Leu	Glu	Asp	Gln	Asp	Phe			
		195					200					205						
Trp	Arg	Met	Ser	Gly	Leu	Phe	Arg	Ser	Val	Thr	Leu	Gln	Ala	Lys	Pro			
	210					215					220							
Arg	Leu	His	Leu	Glu	Asp	Leu	Lys	Leu	Thr	Ala	Ser	Leu	Thr	Asp	Asn			
225					230					235					240			
Tyr	Gln	Lys	Gly	Lys	Leu	Glu	Val	Glu	Ala	Asn	Ile	Ala	Tyr	Arg	Leu			
				245					250					255				
Pro	Asn	Ala	Ser	Phe	Lys	Leu	Glu	Val	Arg	Asp	Ser	Glu	Gly	Asp	Leu			
			260					265					270					
Val	Ala	Glu	Lys	Leu	Gly	Pro	Ile	Arg	Ser	Glu	Gln	Leu	Glu	Phe	Thr			
		275					280					285						
Leu	Ala	Asp	Leu	Pro	Val	Ala	Ala	Trp	Ser	Ala	Glu	Lys	Pro	Asn	Leu			
	290					295					300							
Tyr	Gln	Val	Arg	Leu	Tyr	Leu	Tyr	Gln	Ala	Gly	Ser	Leu	Leu	Glu	Val			
305					310					315					320			
Ser	Arg	Gln	Glu	Val	Gly	Phe	Arg	Asn	Phe	Glu	Leu	Lys	Asp	Gly	Ile			
				325					330					335				
Met	Tyr	Leu	Asn	Gly	Gln	Arg	Ile	Val	Phe	Lys	Gly	Ala	Asn	Arg	His			
			340					345					350					

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Glu	Phe	Asp 355	Ser	Lys	Leu	Gly	Arg 360	Ala	Ile	Thr	Glu	Glu 365	Asp	Met	Ile	
Trp	Asp 370	Ile	Lys	Thr	Met	Lys 375	Arg	Ser	Asn	Ile	Asn 380	Ala	Val	Arg	Cys	
Ser 385	His	Tyr	Pro	Asn	Gln 390	Ser	Leu	Phe	Tyr	Arg 395	Leu	Cys	Asp	Lys	Tyr 400	
Gly	Leu	Tyr	Val	Ile 405	Asp	Glu	Ala	Asn	Leu 410	Glu	Ser	His	Gly	Thr 415	Trp	
Glu	Lys	Val	Gly 420	Gly	His	Glu	Asp	Pro 425	Ser	Phe	Asn	Val	Pro 430	Gly	Asp	
Asp	Gln	His 435	Trp	Leu	Gly	Ala	Ser 440	Leu	Ser	Arg	Val	Lys 445	Asn	Met	Met	
Ala	Arg 450	Asp	Lys	Asn	His	Ala 455	Ser	Ile	Leu	Ile	Trp 460	Ser	Leu	Gly	Asn	
Glu 465	Ser	Tyr	Ala	Gly	Thr 470	Val	Phe	Ala	Gln	Met 475	Ala	Asp	Tyr	Val	Arg 480	
Lys	Ala	Asp	Pro	Thr 485	Arg	Val	Gln	His	Tyr 490	Glu	Gly	Val	Thr	His 495	Asn	
Arg	Lys	Phe	Asp 500	Asp	Ala	Thr	Gln	Ile 505	Glu	Ser	Arg	Met	Tyr 510	Ala	Pro	
Ala	Lys	Val 515	Ile	Glu	Glu	Tyr	Leu 520	Thr	Asn	Lys	Pro	Ala 525	Lys	Pro	Phe	
Ile 530	Ser	Val	Glu	Tyr	Ala	His 535	Ala	Met	Gly	Asn	Ser 540	Val	Gly	Asp	Leu	
Ala 545	Ala	Tyr	Thr	Ala	Leu 550	Glu	Lys	Tyr	Pro	His 555	Tyr	Gln	Gly	Gly	Phe 560	
Ile	Trp	Asp	Trp	Ile 565	Asp	Gln	Gly	Leu	Glu 570	Lys	Asp	Gly	His	Leu 575	Leu	
Tyr	Gly	Gly	Asp 580	Phe	Asp	Asp	Arg	Pro 585	Thr	Asp	Tyr	Glu	Phe 590	Cys	Gly	
Asn	Gly	Leu 595	Val	Phe	Ala	Asp	Arg 600	Thr	Glu	Ser	Pro	Lys 605	Leu	Ala	Asn	

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Val	Lys	Ala	Leu	Tyr	Ala	Asn	Leu	Lys	Leu	Glu	Val	Lys	Asp	Gly	Gln
610						615					620				
Leu	Phe	Leu	Lys	Asn	Asp	Asn	Leu	Phe	Thr	Asn	Ser	Ser	Ser	Tyr	Tyr
625					630					635					640
Phe	Leu	Thr	Ser	Leu	Leu	Val	Asp	Gly	Lys	Leu	Thr	Tyr	Gln	Ser	Arg
				645					650					655	
Pro	Leu	Thr	Phe	Gly	Leu	Glu	Pro	Gly	Glu	Ser	Gly	Thr	Phe	Ala	Leu
			660					665					670		
Pro	Trp	Pro	Glu	Val	Ala	Asp	Glu	Lys	Gly	Glu	Val	Val	Tyr	Arg	Val
		675					680					685			
Thr	Ala	His	Leu	Lys	Glu	Asp	Leu	Pro	Trp	Ala	Asp	Glu	Gly	Phe	Thr
	690					695					700				
Val	Ala	Glu	Ala	Glu	Glu	Val	Ala	Gln	Lys	Leu	Pro	Glu	Phe	Lys	Pro
705					710					715					720
Glu	Gly	Arg	Pro	Asp	Leu	Val	Asp	Ser	Asp	Tyr	Asn	Leu	Gly	Leu	Lys
				725					730					735	
Gly	Asn	Asn	Phe	Gln	Ile	Leu	Phe	Ser	Lys	Val	Lys	Gly	Trp	Pro	Val
			740					745					750		
Ser	Leu	Lys	Tyr	Ala	Gly	Arg	Glu	Tyr	Leu	Lys	Arg	Leu	Pro	Glu	Phe
		755					760					765			
Thr	Phe	Trp	Arg	Ala	Leu	Thr	Asp	Asn	Asp	Arg	Gly	Ala	Gly	Tyr	Gly
	770					775					780				
Tyr	Asp	Leu	Ala	Arg	Trp	Glu	Asn	Ala	Gly	Lys	Tyr	Ala	Arg	Leu	Lys
785					790					795					800
Asp	Ile	Ser	Cys	Glu	Val	Lys	Glu	Asp	Ser	Val	Leu	Val	Lys	Thr	Ala
			805						810					815	
Phe	Thr	Leu	Pro	Val	Ala	Leu	Lys	Gly	Asp	Leu	Thr	Val	Thr	Tyr	Glu
			820					825					830		
Val	Asp	Gly	Arg	Gly	Lys	Ile	Ala	Val	Thr	Ala	Asp	Phe	Pro	Gly	Ala
		835					840					845			
Glu	Glu	Ala	Gly	Leu	Leu	Pro	Ala	Phe	Gly	Leu	Asn	Leu	Ala	Leu	Pro
	850					855					860				

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Lys	Glu	Leu	Thr	Asp	Tyr	Arg	Tyr	Tyr	Gly	Leu	Gly	Pro	Asn	Glu	Ser
865					870					875					880